مذكرة رقم : 049X24

19 فبراير 2024

إلى السيدات والسادة

مديرة ومديري الأكاديميات الجهوية للتربية والتكوين

المديرات والمديرين الإقليميين

المفتشات والمفتشين التربويين للتعليم الثانوي

مديرات ومديري الثانويات التأهيلية

أستاذات وأساتذة التعليم الثانوي التأهيلي

الموضوع : **الإطار المرجعي المكيف لاختبارات الامتحان الوطني الموحد للبكالوريا - 2024**

- مادة علوم الحياة والأرض: شعبة العلوم التجريبية مسلك علوم الحياة والأرض خيار أنجليزية -

المرجع :
- قرار وزير التربية الوطنية والتعليم العالي وتكوين الأطر والبحث العلمي رقم 2385.06 بتاريخ 23 رمضان 1427 (16 أكتوبر 2006) في شأن تنظيم امتحانات نيل شهادة البكالوريا كما تم تغييره وتتميمه؛
- المذكرة الوزارية رقم 001X24 بتاريخ 02 يناير 2024 في شأن تكييف تنظيم السنة الدراسية 2023/2024
- المذكرة الوزارية رقم 086X24 بتاريخ 25 يناير 2024 في شأن الوثيقة المرجعية الخاصة بتكييف البرامج الدراسية

سلام تام بوجود مولانا الإمام،

وبعد، فإلحاقا بالمراجع المشار إليها أعلاه، ومواصلة للجهود الرامية إلى الرفع من جودة التعلمات المدرسية، وانسجاما مع التوجهات الهادفة إلى تحسين الممارسة التقويمية والرفع من مصداقيتها، عملت الوزارة على إعداد الإطار المرجعي **المكيف** للامتحان الوطني الموحد للبكالوريا الخاص بمادة **علوم الحياة والأرض شعبة العلوم التجريبية مسلك علوم الحياة والأرض خيار أنجليزية** لاعتماده في بناء مواضيع اختبارات المادة المذكورة بالامتحان.

وقد تم إعداد هذا الإطار المرجعي والمصادقة عليه من طرف لجن وطنية تخصصية بتمثيلية الأكاديميات الجهوية للتربية والتكوين.

المملكة المغربية

1. الأهداف

وتتحدد الأهداف من اعتماد الأطر المرجعية في:

1.1. التحديد الأدق لما يجب أن يستهدفه الامتحان الوطني الموحد للبكالوريا من كفايات ومهارات ومضامين وذلك بهدف التوجيه الأنجع لتدخلات مختلف الفئات المعنية بإعداد المترشحين والمترشحات لاجتياز هذا الامتحان؛

2.1. الرفع من درجة صلاحية مواضيع الامتحانات الإشهادية بجعلها أكثر تغطية وتمثيلية للمنهاج الدراسي الرسمي؛

3.1. تدقيق الأساس التعاقدي للامتحان بالنسبة لجميع الأطراف المعنية من مدرسات ومدرسين وتلميذات وتلاميذ ولجن إعداد المواضيع؛

4.1. اعتماد معيار وطني موحد لتقويم مواضيع الامتحانات الإشهادية؛

5.1. توفير موجهات لبناء فروض المراقبة المستمرة واستثمار نتائجها في وضع الآليات الممكنة من ضمان تحكم المتعلمات والمتعلمين في الموارد والكفايات الأساسية للمناهج الدراسية.

2. بنية الإطار المرجعي

يستند وضع الأطر المرجعية لمواضيع الامتحانات الإشهادية على التحديد الدقيق والإجرائي لمعالم التحصيل النموذجي للمتعلمين وللمتعلمات عند نهاية السلك التعليمي وذلك من خلال:

2.1. ضبط الموارد الدراسية المقررة في السنة النهائية لسلك البكالوريا مع حصر درجة الأهمية النسبية لكل مجال من مجالاتها داخل المنهاج الرسمي لكل مادة دراسية؛

2.2. تعريف الكفايات والمهارات والقدرات المسطرة لهذا المستوى التعليمي تعريفا إجرائيا، مع تحديد درجة الأهمية بالنسبة لكل مستوى مهاري داخل المنهاج الرسمي للمادة الدراسية المعنية؛

3.2. تحديد شروط الإنجاز.

3. توظيف الإطار المرجعي

توظف الأطر المرجعية في بناء مواضيع الاختبارات المتعلقة بمختلف المواد المعنية بالامتحان وذلك بالاستناد إلى المعايير التالية:

1.3. **التغطية** : أن يغطي موضوع الامتحان كل المجالات المحددة في الإطار المرجعي الخاص بكل مادة دراسية.

2.3. **التمثيلية** : أن تعتمد درجة الأهمية المحددة في الإطار المرجعي لكل مجال من مجالات الموارد الدراسية ولكل كفاية أو مستوى مهاري في بناء موضوع الاختبار وذلك لضمان تمثيلية هذا الأخير للمنهاج الرسمي المقرر.

3.3. **المطابقة** : أن يتم التحقق من مطابقة الوضعيات الاختبارية للمحددات الواردة في الإطار المرجعي على ثلاث مستويات:

مديرية التقويم وتنظيم الحياة المدرسية والتكوينات المشتركة بين الأكاديميات
- المركز الوطني للتقويم والامتحانات
البريد الالكتروني: cne@men.gov.ma ☎ : 0537714453/32 📠 : 0537714437/08/09

- الكفايات والمهارات؛
- الموارد الدراسية ومجالاتها؛
- شروط الإنجاز.

هذا، وحتى يحقق هذا الإجراء الأهداف المتوخاة منه، باعتباره خطوة أساسية للرفع من صلاحية وموثوقية الامتحانات الإشهادية، يشرفني أن أطلب منكم الحرص على تنفيذ ما يلي:

- ✓ استنساخ هذه المذكرة وتوزيعها على المعنيين بالموضوع من مفتشات ومفتشين تربويين وأستاذات وأساتذة مع العمل على إطلاع مختلف المترشحين والمترشحات لامتحانات البكالوريا على فحواها؛
- ✓ تمكين السيدات والسادة المفتشات والمفتشين التربويين للمواد المعنية بالامتحان من عقد اجتماعات ولقاءات تربوية لإطلاع المتدخلين المعنيين على مضامين هذا الإطر المرجعي؛
- ✓ دعوة السيدات والسادة المفتشات والمفتشين التربويين إلى تنظيم لقاءات تربوية مع السيدات والسادة الأستاذات والأساتذة لاعتماد هذه الأداة في التخطيط للتدريس وتوظيفها في إعداد فروض المراقبة المستمرة.

واعتبارا للأهمية البالغة التي يكتسيها هذا الموضوع، فإني أهيب بالجميع، كل من موقعه، إيلاءه كل الاهتمام والعناية اللازمتين.

و السلام.

وزير التربية الوطنية والتعليم الأولي والرياضة

شكيب بنموسى

مديرية التقويم وتنظيم الحياة المدرسية والتكوينات المشتركة بين الأكاديميات
- المركز الوطني للتقويم والامتحانات
البريد الالكتروني: cne@men.gov.ma ☎ : 0537714453/52 : 0537714437/08/09

الأطر المرجعية المكيفة الخاصة بالامتحان الوطني الموحد لنيل شهادة البكالوريا -2024 -

الإطار المرجعي لمادة علوم الحياة والأرض

شعبة علوم تجريبية / مسلك علوم الحياة والأرض – خيار أنجليزي

المركز الوطني للتقويم والامتحانات

2024

INTRODUCTION

This document is a reference framework for the National Moroccan Baccalaureate Exam – International English Options for Life and Earth Sciences: Experimental Sciences Section - Life and Earth Sciences Stream. It is divided into three sections specifying the major areas of assessment and outlining the major components to be included in designing Baccalaureate tests for Life and Earth Sciences Stream.

Section I includes areas of assessment that:

1. **Specify** the competences targeted by the second year Baccalaureate programme - Life and Earth Sciences Stream.
2. **Identify <u>four</u>** content domains:
   a. organic matter consumption and the flow of energy at the cellular level.
   b. the nature of genetic information and the gene expression mechanisms - Genetic engineering.
   c. transmission of genetic information through sexual reproduction and human genetics;
   d. immunology.
3. **Classify** content distribution for second year Baccalaureate programme (Experimental Sciences section - Life and Earth Sciences Stream).

Section II depicts the organisation of notional and methodological domains:

1. Table of contents.
2. Skills table.
3. Specification Table: Knowledge and Skills.

Section III deals with the design components and rubrics of the National Baccalaureate Exam.

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Ministère de l'Education Nationale du Préscolaire et des Sports
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I. Domains of assessment:

1. Specific competences targeted by the second year Baccalaureate programme - Life and Earth Sciences Stream.

According to the pedagogical guidelines and the specific teaching programs for Life and Earth Sciences at the secondary school, the target competences for Life and Earth Sciences Stream are:

- **to acquire** knowledge of the organic matter consumption and the flow of energy at the cellular level with a view to **understanding** the importance of energy in cellular activity and **become aware** of its role in maintaining the vital functions of the organism.
- **to deepen** knowledge of the nature of genetic information, the gene expression mechanisms and **the principles and techniques of genetic engineering** in order to **use** them in **understanding** and **explaining** heredity phenomena in living beings.
- **to acquire** knowledge of the transmission of genetic information through sexual reproduction and **use** this knowledge to solve problems related to the transmission of hereditary characteristics/traits and to sensitize learners to take the necessary precautions against hereditary diseases.
- **to deepen** knowledge on the functioning and dysfunctioning of the immune system, and the means of reinforcing this system. Use this knowledge to understand problems related to immunity to take the necessary precautions against health risks.
- **to adopt a suitable scientific approach to deal with issues related to:**
  a. the organic matter consumption and the flow of energy at the cellular level.
  b. genetics.
  c. immunology.
- **to use various modes of expression** (oral, written and graphic) to communicate and present phenomena **related to:**
  a. the organic matter consumption and the flow of energy at the cellular level;
  b. genetics.
  c. immunology.
- **to use laboratory equipment** and ICT (Information and Communication Technology) in the collection and processing of data **related to:**
  a. the organic matter consumption and the flow of energy at the cellular level.
  b. genetics.
  c. immunology.

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2. Content domains:

2.1. First content domain: organic matter consumption and the flow of energy at the cellular level.

This domain allows the learner to get further knowledge of the organic matter consumption and the flow of energy at the cellular level through the knowledge of aspects related to these phenomena. The aim of this domain is to help the learner understand the mechanism of the use of organic matter by the living cell in order to supply itself with the energy needed for its activity.

The study of reactions responsible for the stored energy release in organic matter in the cell consists of:

- focusing on essential reactions allowing ATP production during respiration and during fermentation.
- determining the energy yield of these reactions.
- knowing the cellular structures responsible for ATP production.
- comparing efficiency of ATP production for respiration and fermentation.

The study of the role of the skeletal striated muscle in energy conversion consists of:

- showing that the muscle cell is the structural and functional unit of muscle contraction through the study of the structure and the ultra-structure of this muscle cell.
- showing the relationship between the structure and the ultra-structure of the muscle cell on the one hand, and the muscle contraction mechanism and the accompanying phenomena on the other.
- highlighting the conversion of chemical energy (ATP) in mechanical energy during muscle contraction.
- determining the different regeneration pathways of ATP in the muscle cell.

At the end of the above content domain, it is necessary that the learner manage to construct a synthetic flowchart summarising the relationships between the different reactions those which release energy, and those which consume it by placing emphasis on the role of the ATP molecule as an energy intermediary.

2.2. Second content domain: Nature of genetic information and the gene expression mechanisms - Genetic engineering.

This domain allows the learner to acquire knowledge of genetic information concerning its nature, its transmission from the mother cell to the daughter cells and its expression mechanisms. It also allows the learner to know some principles and techniques of genetic engineering.

The construction of the notion of genetic information consists of:

- highlighting the location of genetic information in the cell in unicellular and multi-cellular living beings.
- determining the mechanism by which the genetic information is transmitted from one cell to another.
- constructing the notion of cell cycle by studying the phases of mitosis and interphase and describing the behavior of chromosomes to deduce that mitosis is a process of cell division resulting in two genetically identical daughter cells.
- highlighting the chemical nature of genetic information and determining the structure and the replication mechanism of DNA, with an emphasis on the relationship between the evolution of DNA amount and chromosomes during the cell cycle.
- defining the notions of inherited characteristics/traits, gene, allele, and mutation.

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- establishing the relationship between trait-protein and gene-protein, which allows to deepen the notions of mutation and gene and construct the notion of the genetic code.
- highlighting the relationship between genetic information and the proteins synthesis through the study of the mechanisms and stages of gene expression inside the cell: using the genetic code to explain the gene expression (transcription and translation).

The knowledge acquisition of some principles of genetic engineering consists of:

- Constructing the notion of genetic modification by highlighting the principle of genetic transformation through an example of natural transfer of genes from a bacterium (*Agrobacterium tumefaciens*) to a plant cell.
- Using the principle of genetic transformation to explain genetic engineering techniques.

2.3. Third content domain: Transmission of genetic information through sexual reproduction and human genetics.

The study of the transmission of genetic information through sexual reproduction consists of highlighting the role of meiosis and fertilisation in the karyotype stability, and in the recombination and genetic diversity. To achieve that, it is necessary to:

- define meiosis, identify its different phases and show its role in the recombination of alleles (genetic recombination of homologous chromosomes by linkage/crossing-over and chromosomes independent assortment), and therefore deduce the genetic diversity of gametes.
- define fertilisation and show its role in genetic recombination and in genetic diversity of individuals within the same species.
- show the role of alternation of fertilisation and meiosis in karyotype stability in individuals of the same species from one generation to the next.

The study of Mendel's laws explaining the transmission of hereditary characteristics/traits in diploid organisms consists of:

- formulating the notion of genotype, pure lineage (wild type and mutant) and hybridization.
- learning Mendel's laws and their exceptions through the study of examples of autosomal monohybridism (dominance and codominance, lethal gene), sex-linked gene and dihybridism (independent and linked genes);
- showing the role of linkage/crossing-over in genetic diversity of generations and gene mapping/construction of gene maps.

The study of human genetics consists of:

- knowing the methods and the means of studying the transmission of hereditary characteristics/traits in humans (pedigree, karyotypes) and studying the modes of transmission of some hereditary autosomal and sex-linked diseases using pedigree, karyotypes, and gene detection techniques.
- highlighting certain chromosomal abnormalities and their consequences by using karyotypes.

2.4. Fourth content domain: Immunology.

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This domain allows the learner to construct the notion of self and non-self, to know the different types and mechanisms of the immune response, and to know the dysfunctions of the immune system and its support system. This domain enables the learner to:

- **know** the self-markers (the Major Histocompatibility Complex (MHC) proteins and the cell surface markers on human red blood cells of the ABO Blood Groups) and deduce the role of the MHC proteins in the presentation of the self and the non-self (notion of self and non-self).
- **distinguish / recognize** the means of the nonspecific and specific immune response.
- **describe and interpret** aspects of the inflammatory response and phagocytosis and then demonstrate their roles as a means of nonspecific immunity.
- **know** the elements of the immune system and the origin of the immune cells as well as the organs responsible for the maturation of lymphocytes.
- **know** the mechanisms and the characteristics of the specific immune response (humoral and cellular) and determine the role of cellular cooperation.
- **realize/construct** a synthetic flowchart summarising the steps of the immune response and showing the relationship between the nonspecific response and the specific response.
- **study** some immune system disorders through the determination of the elements and mechanisms involved in allergy due to immediate hypersensitivity and those involved in AIDS that results from an immunodeficiency due to the destruction of the specific immune response (structure of HIV, its infection cycle, its effect on T4 lymphocytes and the HIV evolution and progression to AIDS).
- **study** the ways to boost the immune system by recalling the notion of adaptive (acquired) immunity response and the notion of immune memory on which the principle of vaccination is based, and the ways to reinforce the humoral immune response on which serotherapy is based.
- **know** the technique of bone marrow transplantation as a means of the immune system reinforcement.
- **use** previous knowledge **to interpret** the serotherapy principles, vaccination, and bone marrow transplantation as a means of reinforcing the immune system.

3. Content distribution of second year Baccalaureate program, Experimental Sciences Section - Life and Earth Sciences Stream:

(Refer to the reference document regarding the adaptation of curriculum for the academic programs - Preparatory Secondary Education Track, issued by the Curriculum Directorate - January 2024)

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II. Organisation of notional and methodological domains.

1. Table of content.

Domain 1: The organic matter consumption and the flow of energy at the cellular level. (Coverage 22,5%)		
Sub-domains	**Content**	**Basic objectives (notional / methodological)**
1.1. The reactions responsible for the release of the stored energy in organic matter in the cell	- Notion of respiration ; - Notion of fermentation ; - The main stages of glycolysis. - Energy yield from glycolysis. - Mitochondrion structure and ultra-structure. - The main stages of the Krebs cycle. - Energy yield of the Krebs cycle. - Electron Transport Chain and oxidative phosphorylation - Energy yield of respiration. - The main stages of fermentation. - Energy yield of fermentation. - Energy efficiency.	- **Compare** respiration and fermentation through the exploitation of data based on observation and experimentation. - **Show/highlight** the relationship between respiration, fermentation and the cellular structures involved through the exploitation of data based on observation and experimentation. - **Apply** scientific reasoning (**formulate** a problem, **make/test/verify** a hypothesis, suggest an experimental protocol…) while studying data related to respiration and fermentation. - **Deduce** the conditions of respiration and fermentation through the exploitation of data based on observation and experimentation. - **Determine** the main stages of the reactions responsible for the release of the energy stored in organic matter and **deduce** its energy yield. - **Describe** the components, the structure and ultra-structure of the mitochondrion and relate them to the reactions of cellular respiration. - **Compare** the energy yield of respiration and of fermentation. - **Calculate** energy efficiency of respiration and of fermentation. - **Represent** the aspects of respiration and of fermentation **using graphs**. - **Draw /make** an energy yield flowchart of respiration and of fermentation.
1.2. The role of the skeletal striated muscle in energy conversion	- Thermal and chemical phenomena accompanying the muscle contraction. - Skeletal muscle structure and ultra-structure. - Molecular structure of the myofilaments. - Source of the energy necessary for the muscle contraction. - Muscle contraction mechanism. - Metabolic pathways of ATP regeneration.	- **Compare** the state of a muscle fiber at rest and during a contraction. - **Apply** scientific reasoning (**formulate** a problem, **make/ test/verify** a hypothesis, suggest an experimental protocol…) while studying data related to muscle contraction. - **Use** the structure and ultra-structure of the skeletal muscle cell in order to **explain** the mechanisms of muscle contraction. - **Determine** thermal and chemical phenomena accompanying the muscle contraction. - **Show/highlight** the relationship between thermal and chemical phenomena and muscle contraction. - **Deduce** metabolic pathways for ATP regeneration required for muscle contraction.

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		- **Show/highlight** the relationship between the pathways of ATP regeneration and the type of physical effort. - **Draw/make** diagram/ flowchart of muscle contraction mechanism.
1.3. Outcome: synthetic flowchart of organic matter consumption and energy flow in the cell	Pre-requisite knowledge in this area.	**Draw** a flowchart of the consumption of organic matter and energy flow in the cell.

Domain 2: nature of genetic information and the gene expression mechanisms - Genetic engineering. (Coverage 25%)		
Sub-domains	**Content**	**Basic objectives (notional / methodological)**
2.1. The notion of genetic information	- The location of genetic information in the nucleus of the cell. - The role of chromosomes in the transmission of genetic information from one cell to another: • phases of mitosis in animal cells. • The Cell cycle. - The chemical nature of genetic material: • Composition and structure of chromosomes and DNA. • Mechanism of DNA replication. - The notions of inherited characteristics/traits, gene, allele, and mutation. - The relationship between trait -protein and gene-protein. - The meaning of gene mutation. - The genetic code.	- **Deduce** the location of genetic information in the nucleus of the cell through **data analysis**. - **Describe** and **identify** phases of mitosis. - **Construct** and **represent** the cell cycle and **deduce** its role in the stability of genetic information. - **Deduce** the role of chromosomes in the transmission of genetic information from one cell to another through exploitation of data based on observation and experimentation. - **Determine** the chemical nature of genetic material through exploitation of data based on observation and experimentation with the aim of applying scientific reasoning (**formulate** a problem**, make/ test/verify a hypothesis, suggest** an experimental protocol…). - **Show/ highlight** the relationship between chromosomes and DNA molecule. - **Show/ highlight** the role of the DNA replication in the stability of genetic information. - **Show/ highlight** the relationship between traits - protein and gene-protein through **data exploitation**. - Deduce the meaning of gene mutation by using genetic code. - **Draw schemes** related to mitosis phases and chemical nature of genetic material.
2.2. The gene expression mechanisms: Protein synthesis stages	- Structure of RNA. - Transcription. - Translation (initiation, elongation and termination).	- **Describe** and **interpret/explain** the process of transcription of RNA molecule. - **Show / highlight** the relationship between DNA, RNA and protein by using genetic code (the meaning of the genetic code). - **Describe** the stages of protein synthesis. - **Draw a diagram** summarizing the stages of proteins synthesis.

2.3. Genetic engineering: its principles and techniques	The stages of gene transfer - the notion of genetic transformation: • natural gene transfer from *Agrobacterium Tumefaciens* to a plant. • techniques and steps of transferring a gene to a bacterium.	- **Infer** the techniques and steps of gene transfer, **deduce** the genetic transformation notion by studying-a specific example. - **Draw/make** a diagram summarising the techniques and stages of genetic engineering.

Domain 3: Transmission of genetic information through sexual reproduction - Human genetics (Coverage 25%)		
Sub-domains	**Content**	**Basic objectives (notional / methodological)**
3.1. The transmission of genetic information through sexual reproduction	- Stages/phases of meiosis. - Karyotypes of diploid species. - Role of meiosis and fertilization in allelic recombination/ recombination of alleles (genetic recombination of homologous chromosomes by linkage/crossing-over and chromosomes independent assortment) and in karyotype stability across generations.	- **Describe** and **recognize** the meiosis phases. - **Analyze** karyotypes of diploid species. - **Deduce** through exploitation of data based on observation and experimentation: o **the** role of meiosis and fertilization in allelic recombination and in the karyotype stability in the same species from one generation to the next. o **the** role of meiosis and fertilization in genetic diversity - **Draw** diagrams in relation to the meiosis phases;
3.2. Mendel's laws of the transmission of hereditary characteristics/traits in the diploid organisms	- Mendel's laws of the transmission of hereditary characteristics/traits. - Monohybridism/ Monohybrid Cross. - Dihybridism/dihybrid cross. - Pure lineage and wild type, homozygosity and heterozygosity, hybridization, test cross/back cross. - Punnett squares. - Autosomal heredity (independent of sex) and sex-linked heredity. - Dominance, codominance, and lethal gene. - Unlinked genes (genes of independent assortment); - Linkage/crossing-over, genetic recombination of homologous chromosomes by linkage/crossing-over and genetic diversity. - Gene maps.	- **Analyze** and **interpret** the results of the transmission of a couple of alleles from the study of a specific example (in cases of a sex-linked gene and autosomal gene); - **Analyze** and **interpret** the results of the transmission of two couples of alleles from the study of a specific example (in cases of two unlinked genes and two linked genes); - **Draw a diagram of** genetic recombination **of** homologous chromosomes by linkage/crossing-over and independent assortment of homologous chromosomes, according to the example studied. - **Calculate** the distance between linked genes and **draw** a gene map/gene mapping.

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3.3. Human genetics	- Notions of pedigree and karyotype. - Hereditary autosomal diseases. - Hereditary sex-linked diseases. - Chromosomal abnormalities and their consequences. - Chromosomal interpretation of hereditary diseases.	- **Analyze**, **interpret,** and **explain** pedigree and karyotype data by inferring/deducing the mode of transmission of a gene in the case of: o Hereditary autosomal diseases. o Hereditary sex-linked diseases. - **Analyze, interpret/explain** the chromosomal abnormalities by drawing appropriate diagrams. - **Give opinion** on the prenatal diagnosis of chromosomal abnormalities based on **data exploitation.**

Domain 4: Immunology (Coverage 27,5 %)		
Sub-domains	**Content**	**Basic objectives (notional / methodological)**
4.1. Concept of self and non-self	- Definition of the major histocompatibility complex (MHC) proteins and determination of its role. - The notion of self. - The cell surface markers on human red blood cells of the ABO Blood Groups. - The notion of non-self and modified self. - The genetic characteristics of the (MHC) proteins.	- **Analyze** experimental data about self and non-self. - **Deduce** the role of the self identity markers in the presentation of the self and the non-self. - **Infer** the genetic characteristics of the (MHC) proteins.
4.2. The ways how the human organism protects the self.	- Notion of immune response; - The nonspecific immune response: inflammatory response, phagocytosis and complement system. - The adaptive (acquired) immunity response - both humoral and cell-mediated: • The elements responsible for this response. • The mechanisms and characteristics of the specific immune response (specificity and immunological memory). • The organs of the immune system. • Origin of immune cells and lymphocyte maturation sites. • The phases of the specific immune response (induction, amplification, and effector phases). • Cellular cooperation.	- **Describe and explain** the events of inflammatory response and phagocytosis. - **show** the role of inflammatory response and phagocytosis as natural defenses (nonspecific immune response). **-Exploit, use by applying** a scientific approach, the data of the observation and the experimentation in relation with the stages and the mechanisms of the specific immune response. - **Apply** scientific reasoning (formulate the problem, propose and test the hypothesis, propose an experimental protocol ...) to the data related to the immune response; - **Show** the role of cellular cooperation in the specific immune response through exploitation of data based on observation and experimentation. - **Graphically represent** the manifestations and mechanisms of the immune response; - **Draw /make** a summary diagram/flowchart of the stages of the immune response.

4.3. Some dysfunctionings of the immune system	- Elements and mechanisms of allergy due to immediate hypersensitivity. - The acquired immunodeficiency syndrome: • HIV structure and its infection cycle. • Action of HIV on $CD4^+$ T cells. • HIV evolution and progression to AIDS.	- **Determine** the elements and **show** the allergy mechanisms related to immediate hypersensitivity through exploitation of data based on observation and experimentation. - **Exploit, use** data (acquired and documents) to explain the effect of HIV on the immune system. - **Graphically represent** the effect of HIV on the immune system. - **Draw /make** a summary diagram/flowchart concerning the dysfunctionings of the immune system.
4.4. Ways of helping the immune system	- Vaccination. - Serotherapy. - Bone marrow transplantation.	- **Use data and** pre-requisite knowledge **to explain** the principles of vaccination, serotherapy and bone marrow transplantation as a means of helping the immune system. - **Show/highlight** the importance of vaccination, passive immunotherapy, and bone marrow transplantation as a means of helping the immune system.

Royaume du Maroc
Ministère de l'Education Nationale du Préscolaire et des Sports
Centre National de l'Evaluation des Examens

2. Skills Table.

Skills domains	Skills	Weighting in (%)
Knowledge Retrieval.	This Section, knowledge retrieval, aims to assess the degree of mastery of content using the following: - Multiple choice questions (MCQ). - True/false statements. - Matching. - Classification/seriation/rearranging. - Short-answer questions (give definitions, label a diagram or a graph, and know theories, laws, scientific terms, facts, signs, etc.).	**25%**
Scientific reasoning and communication in graphic and written modes.	This Section, **scientific reasoning, and communication in graphic and written modes, aims** to assess the degree of mastery of skills and competencies: - **Determine** and **formulate** a scientific problem. - **Use** background knowledge, **select,** and **organize** information in relation to the subject of study. - **Link** information with acquired knowledge to resolve a scientific problem. - **Make/formulate** a hypothesis in relation to a scientific problem. - **Use knowledge** to solve a scientific problem or to **explain** the phenomena under study. - **Suggest** appropriate tools to **test** hypotheses. - **Describe** and **analyze** scientific data. - **Compare** and **explain/interpret** results. - **Infer** and **generalize the results**. - **Use** principles, laws, models to **explain/interpret** scientific phenomena and data. - **Conduct a synthesis** of information and data and turn it into a text or a diagram. - **Give** an opinion and support it with arguments. - **Present** a structure or biological phenomena using a diagram. - **Turn** numerical data into a chart, a graph, or a text. - **Draw** a functional diagram. - **Achieve/realize** a synthetic flowchart.	**75%**

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Ministère de l'Education Nationale du Préscolaire et des Sports
Centre National de l'Evaluation des Examens

3. Specification table: Knowledge and skills

In accordance with the Ministerial Circular No.10-142, the specification table below specifies the process of assessment in secondary school with regard to Life and Earth Sciences. The national Baccalaureate exam is divided into two sections: Section I is related to knowledge retrieval and Section II is related to scientific reasoning and communication in graphic and written modes.

The circular also emphasises the adoption of a scientific approach and takes into account the time allotted to each content domain in the program in order to set the weighting and scoring.

- Section I deals with knowledge retrieval that allows the assessment of the learners' knowledge in the four content domains.

- Section II deals with scientific reasoning and communication in graphic and written modes which allows the assessment of learners in the four content domains.

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Domains of knowledge (Domains and sub- domains) / Skills		Knowledge Retrieval (25%)	Scientific Reasoning and Communication in graphic and written modes 75%	Total (%)	Scores assigned to each Domain
1. The organic matter consumption and the flow of energy at the cellular level	The reactions responsible for the release of the stored energy in organic matter in the cell;	**7,5 %**	**15 %**	**22,5 %**	**4,5 pts**
	The role of the skeletal striated muscle in energy conversion;				
	Outcome: synthetic flowchart of organic matter consumption and energy flow in the cell;				
2. The Nature of genetic information and the gene expression mechanisms - Genetic engineering.	The notion of genetic information;	**10 %**	**40 %**	**50 %**	**10 pts**
	The gene expression mechanisms: Protein synthesis stages;				
	Genetic engineering: its principles and techniques;				
3. Transmission of genetic information through sexual reproduction - Human genetics.	The Transmission of genetic information through sexual reproduction;				
	Mendel's laws of the transmission of hereditary characteristics/traits in the diploid organisms;				
	Human genetics;				
4. Immunology.	Concept of self and non-self;	**7,5 %**	**20 %**	**27,5 %**	**5,5 pts**
	The ways used by the human organism to protect the self;				
	Some dysfunctionings of the immune system;				
	Ways of supporting the immune system;				
Total (%)		**25%**	**75%**	**100%**	**20 pts**
The scores assigned to each section		**5 pts**	**15 pts**		

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Centre National de l'Evaluation des Examens

III. Design of the National Baccalaureate Exam.

<table>
<tr><th colspan="4">TEST SECTIONS</th></tr>
<tr><td colspan="4">Section I: Knowledge Retrieval</td></tr>
<tr><td colspan="4">This Section, knowledge retrieval, aims to assess the degree of mastery of content using the following:
- Multiple choice questions (MCQ);
- True/false statements.
- Matching.
- Classification/seriation/rearranging.
- Short-answer questions (provide definitions, legend a diagram or a graph, and know theories, laws, scientific terms, facts, signs, etc.).</td></tr>
<tr><td colspan="3">This Section tests the learners' knowledge in the four following content domains:</td><td>Scoring</td></tr>
<tr><td colspan="2">1. The organic matter consumption and the flow of energy at the cellular level.</td><td>1,5 pts</td><td rowspan="4">5 pts</td></tr>
<tr><td colspan="2">2. The nature of genetic information and the gene expression mechanisms – Genetic engineering.</td><td rowspan="2">2 pts</td></tr>
<tr><td colspan="2">3. The transmission of genetic information through sexual reproduction – Human genetics.</td></tr>
<tr><td colspan="2">4. Immunology.</td><td>1,5 pts</td></tr>
<tr><td colspan="4">Section II: Scientific reasoning and communication in graphic and written modes</td></tr>
<tr><td rowspan="3">It comprises 3 or 4 exercises</td><td colspan="2">One exercise related to the organic matter consumption and the flow of energy at the cellular level.</td><td>3 pts</td></tr>
<tr><td colspan="2">One or two exercises related to two content domains of genetics.</td><td>8 pts</td></tr>
<tr><td colspan="2">One exercise related to immunology.</td><td>4 pts</td></tr>
</table>

NB. Necessary exam tools:

In addition to the ID card and the invitation letter for the exam, the candidate must have the following tools:

- **Pens, pencils, ruler, eraser, and a pencil sharpener.**
- **Non-programmable calculator.**
- **Graph paper.**

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